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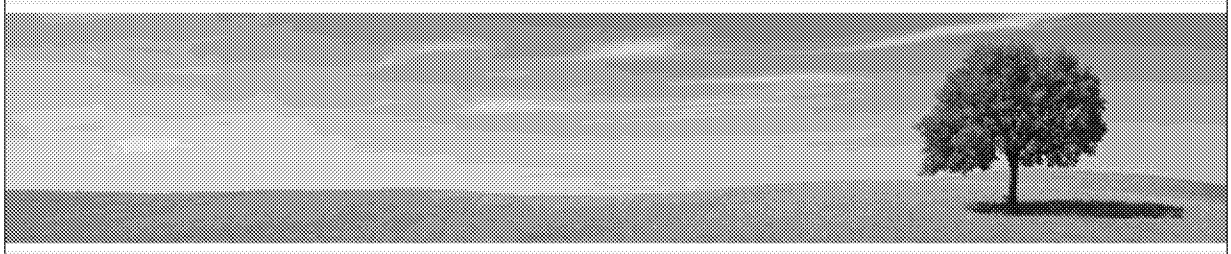
SCIENCE INTEGRITY KNOWLEDGE



Endangered Species Risk Assessment

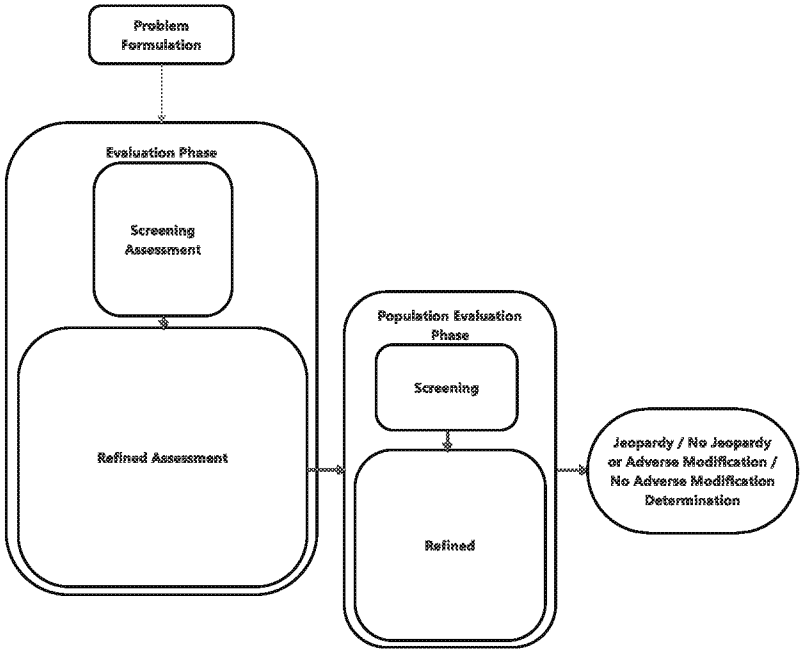
Scott Teed

September 20th, 2018

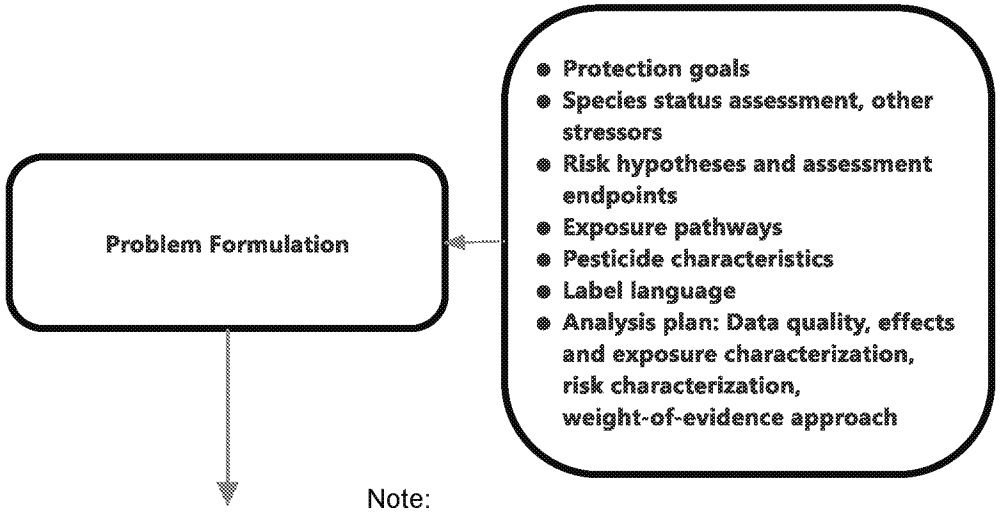
Overview

- CLA ERA Framework
  - Screening vs Refined ERA Risk Characterization
  - Terrestrial and Aquatic Case Studies
  - Lines of Evidence – Weight-of-Evidence
  - Development of Meaningful RPA/RPMs

CLA ESRA Framework



Problem Formulation



Note:

- Conduct data quality evaluations (e.g. literature review – Acceptable, Supplemental, Unacceptable)

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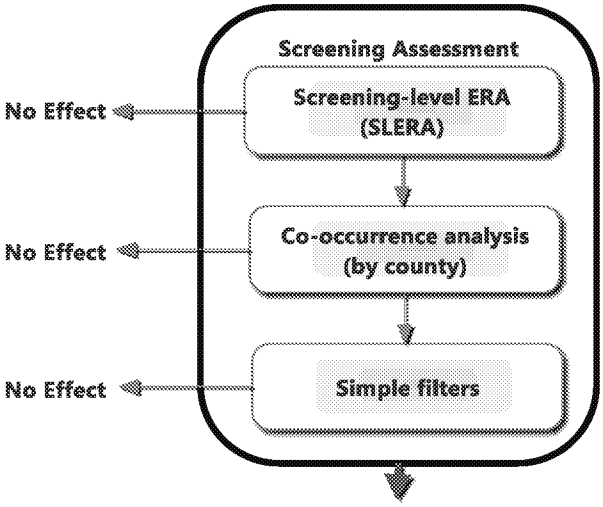
Evaluation Phase: Screening



- **SLERA**
  - FIFRA style
  - Conservative
  - **Coarse filter** to identify tolerant vs sensitive taxa
- **Co-occurrence**
  - Use pattern vs species range overlay
  - Proximity analysis
- **Simple filters**
  - Are there life history, dietary, habitat or location specifics that restrict exposure potential?

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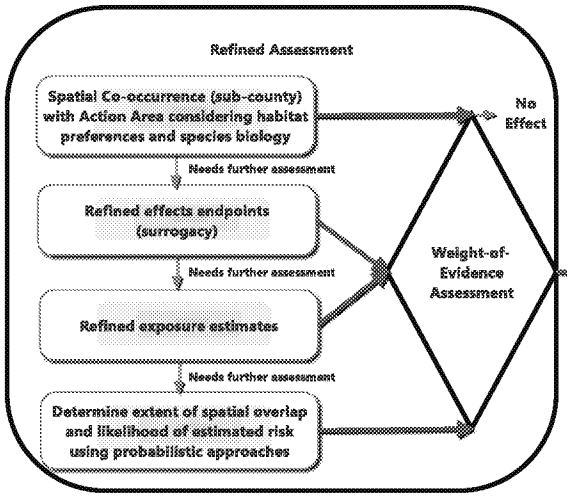
Evaluation Phase: Refined



- Refined Exposure Estimates
  - Refined PWC
  - Watershed modeling (eg. SWAT)
  - Terrestrial exposure
- Probabilistic approaches
  - Percent cropped area (PCA)
  - Probability of spatial overlap given uncertain species ranges and crop variability
  - Variable diets, much more
- Weight-of-evidence assessment
  - Quantitative
  - Qualitative
  - Lines of evidence

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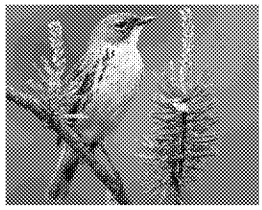
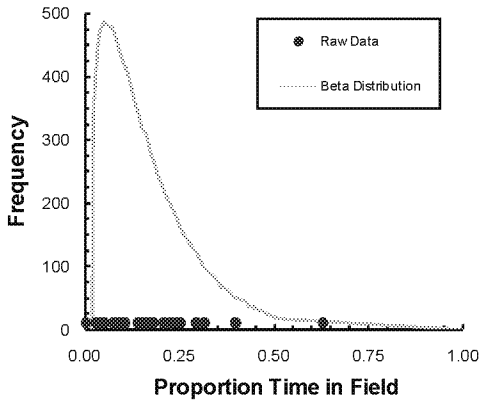
Refined Wildlife ESRA

- Screening-level risk assessments
  - SIP, STIR, KABAM
  - T-REX, T-HERPS
  - AgDRIFT, AgDISP
- Refined risk assessments
  - Advanced deterministic models
  - Probabilistic exposure models for different receptor groups and application methods
  - Dose-response curves
  - Derive risk curves





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Refined Terrestrial Assessment

Kirtland's warbler

- Breeding season model (acute and chronic)
  - 60-day period with 10-minute time step following initial pesticide application
  - Residues adjusted for distance between foraging location and treated crop
  - Probabilistic model that simulates 10,000 birds
- Migration model (acute only because stopovers are brief)
  - Spring and fall migrations through states having orchard crops potentially treated with chlorpyrifos or malathion
  - For each bird, randomly determine: migration duration, length of each stopover, whether stopover in a treated orchard, time since pesticide application
- Results: Very low acute and chronic risk for both pesticides. Consistent with recent proposal to **delist** Kirtland's warbler and other lines of evidence
- Habitat loss and cowbird predation are the issues

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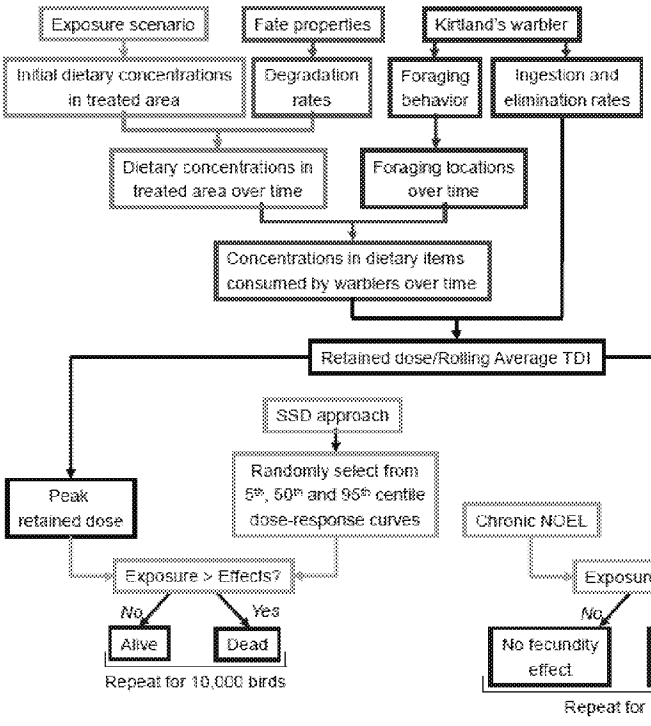

Exposure Models

- **Conservative**
- **SeedPARAM**
- **GranPARAM**
- **LiquidPARAM (Dietary)**
- **WildlifePRAM (Body Burden)**
- **TIM/McNest**

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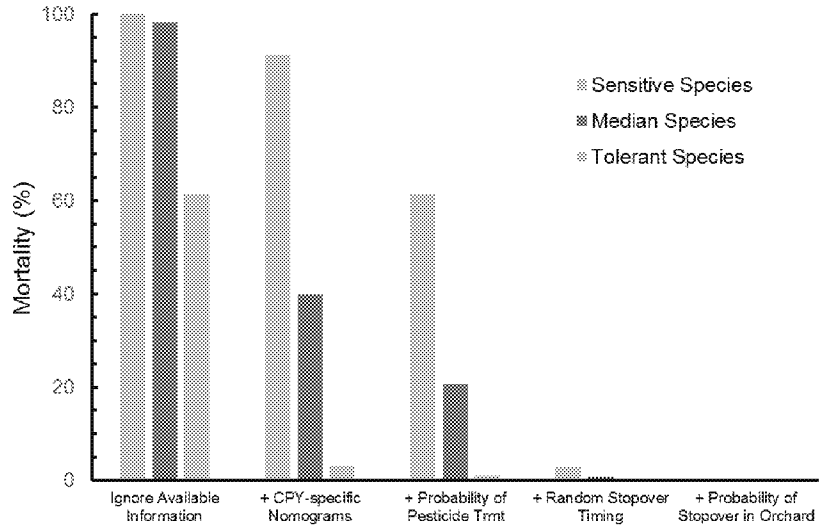
Migration Model: Reality Matters!

Assumed: 100% label rates



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Refined Aquatic Assessment

- **Malathion Aquatic ESRA Project**
  - Following CLA Framework
  - Screening assessment (aquatic) results (RQ > ES-LOCs)
  - Focus on aquatic species

Taxon	*Number of Species Evaluated*	*Number of Species that Received Not of Concern Statements*			*Number of Species with Not of Concern Statements in Step 1*	*Number of Species to be Evaluated in Step 2*
		SLERA	*Co-Occurrence Analysis*	*Species Filters*		
Amphibians	23	15	0	3	18	5
Corals	2	0	0	0	0	2
Crustaceans	23	0	0	4	4	19
Dicots	40	40	0	0	40	0
Ferns and Allies	2	2	0	0	2	0
Fish	133	2	0	26	28	105
Insects	6	0	0	1	1	5
Molluscs	123	0	0	13	13	110
Monocots	21	21	0	0	21	0
Reptiles	19	16	0	0	16	3
TOTAL	392	96	0	47	143	249

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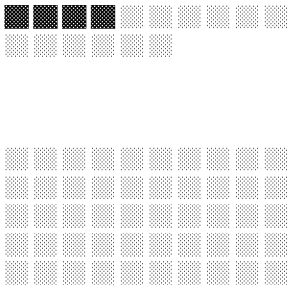
Refined Aquatic Assessment

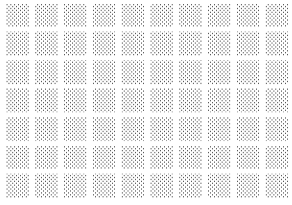
- **Identified 100 aquatic species (crustaceans, fish, molluscs)**
- **Exposure estimates for the aquatic bins**

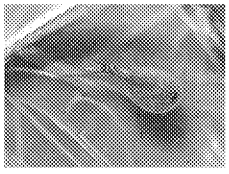
Bin Number	Description	Depth (m)	Width (m)	Length (m)	Flow Rate (m^3/second)
1	Aquatic-associated terrestrial habitats	NA[1]	NA	NA	NA
2	Low Flow	0.1	2	Length of Field[2]	0.001
3	Moderate Flow	1	8	Length of Field	1
4	High Flow	2	40	Length of Field	100
5	Low Volume	0.1	1	1	0
6	Moderate Volume	1	10	10	0
7	High Volume	2	100	100	0
8	Intertidal Near Shore	0.5	50	Length of Field	NA
9	Subtidal Near Shore	5	200	Length of Field	NA
10	Offshore Marine	200	300	Length of Field	NA

Bin 5 (Low – Volume)



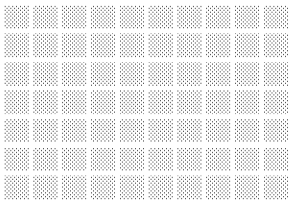
Bin 6 (Moderate – Volume)





Lepidurus packardi

Bin 3 (Moderate -Flow)



High risk or less

Intermediate or less

Low or less

De minimis

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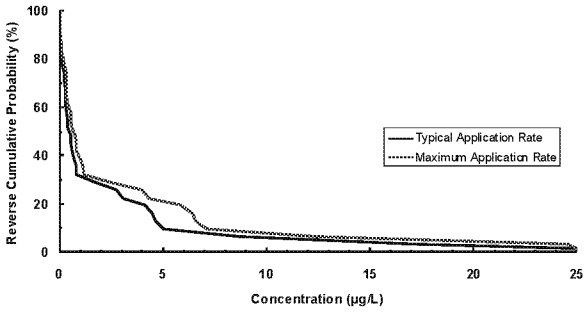
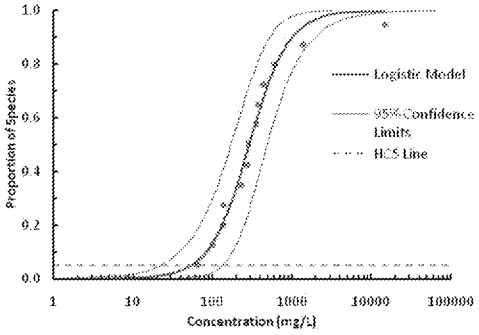
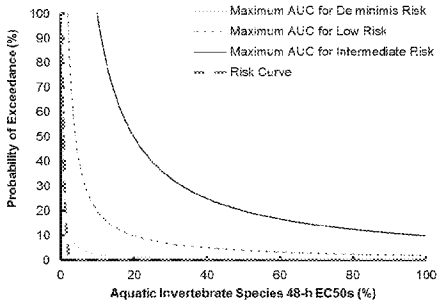


- Surrogacy
  - Concentration – Response
  - NOEC / LOEC
- HC5
- 25-50-75th





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Additional Refined Examples

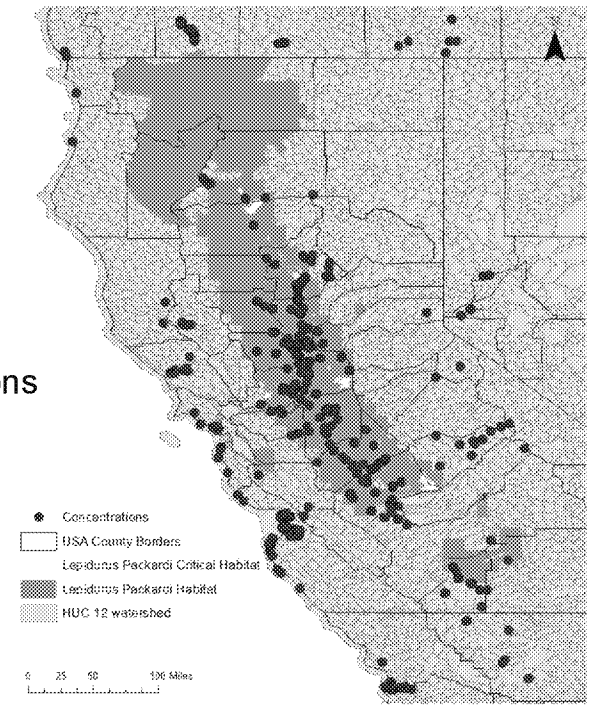
- D.R.J. Moore, C.D. Priest, A.D. Olson, and R.S. Teed. 2018. A probabilistic risk assessment for the Kirtland's warbler potentially exposed to chlorpyrifos and malathion during the breeding season and migration. IEAM 14(2):252-269
- Clemow, Y.H., G.E. Manning, R.L. Breton, M.F. Winchell, L. Padilla, SI. Rodney, J.P. Hanzas, T.L Estes, K. Budreski, B.N. Toth, K.L. Hill, C.D. Priest, R.S. Teed, L.D. Knopper, D.R.J. Moore, C.T. Stone, P. Whatling. 2018. A refined ecological risk assessment for California Red-legged Frog, Delta Smelt, and California Tiger Salamander exposed to malathion. IEAM 14(2):224-239.

Methods

- Brain, R., R.S. Teed, J. Bang, P. Thorbek, J. Perine, N. Peranginangin, M. Kim, T. Valenti, W. Chen, R.L. Breton, S.I. Rodney, D. R.J. Moore. 2014. Risk assessment consideration with regard to the potential impacts of pesticides on endangered species. IEAM 11(1):102-117.
- Budreski, K, M. Winchell, L. Padilla, J. Bang, R.A. Brain. 2015. A probabilistic approach for estimating the spatial extent of pesticide agricultural use sites and potential co-occurrence with listed species for use on ecological risk assessments. IEAM 12(2):315-327.

Lines of Evidence

- Monitoring data
- Incident reports
- Cosm studies
- Field studies
- Field staff observations



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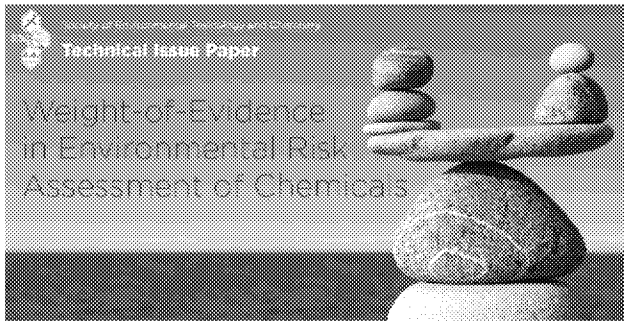
Weight-of-Evidence

- NMFS claimed to use a WoE approach to determine risk and make jeopardy calls
- WoE is the process of assembling, weighing, and evaluating evidence to come to a scientifically defensible conclusion (SETAC TIP)
- Numerous literature reviews available that describe and critique WoE frameworks



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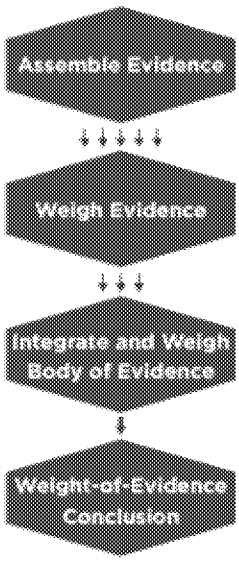
Weight-of-Evidence: General Approach



Identify, filter and summarize available lines of evidence

Assign each piece of evidence a weight based on the evidence's strength, relevance and reliability

Evaluate the lines of evidence together and assess consistency to identify the appropriate conclusion

SETAC Technical Information Paper

Suter II, GW and SM Cormier. 2011. Science of the Total Environment 409:1406–1417.

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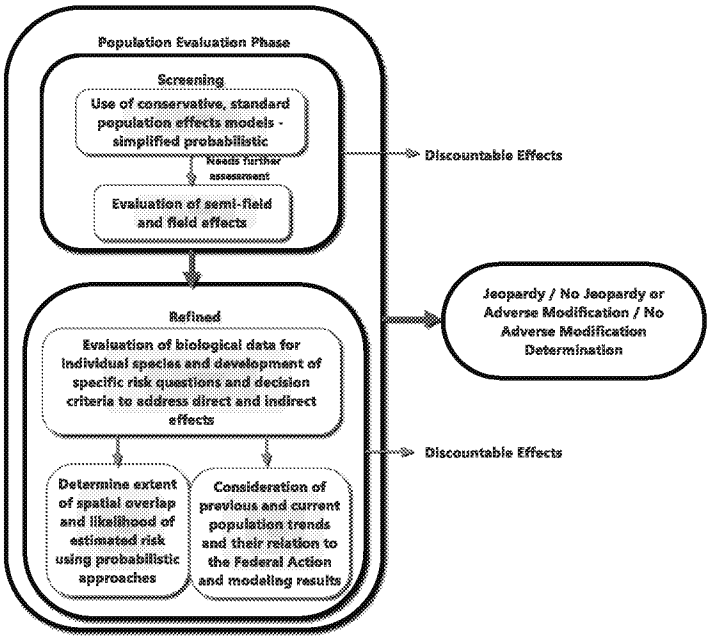
Best Practices

- Derive WoE framework *a priori*, ensure that it is broadly reviewed
- Derive risk questions or hypotheses during problem formulation
- Specify inclusion/exclusion criteria for pieces of evidence
- Do not exclude pieces of information that have null findings or are not supportive of favored risk hypotheses
- Do not exclude potentially important lines of evidence because they have limitations (all lines of evidence have limitations)
- Be transparent
  - Identify sources of information, provide study reviews and scores
  - Provide criteria for weighting of pieces of information and lines of evidence
  - Describe process of weighing body of evidence and arriving at risk conclusions
  - Document sources of uncertainty, specify potential impacts on risk conclusions
- Be objective, do not bias towards worst case, avoid logical inconsistencies
- Document and explain ambiguities and discrepancies

Adapted from Hall et al.. 2017. Integrated Environmental Assessment and Management 13:573–579.
Rhomberg et al. 2013. Critical Reviews in Toxicology 43:753–784.

Population Evaluation: Screening / Refined



- Screening-level
  - Deterministic
  - Scalar models
  - Life-history (matrix) models
- Refined
  - Probabilistic
  - Individual based models
  - Metapopulation models
  - Can be data intensive

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Conclusions

1. Use data are an important consideration when attempting to characterize realistic risk estimates
2. Effect distributions integrated with refined exposure distributions (Risk Curves or Joint Probability Curves) provide a complete story (probabilities of effects of differing magnitude)
3. Weight-of-Evidence approaches are key to ensure use of all available information, provide context and understanding of risk
4. Refined assessments facilitate communication and risk management (localized or national remedies (RPA/RPM), label language)
5. Provides appropriate starting point for population modeling